Low Stress Bike Accessibility to Supermarkets in Greater Boston
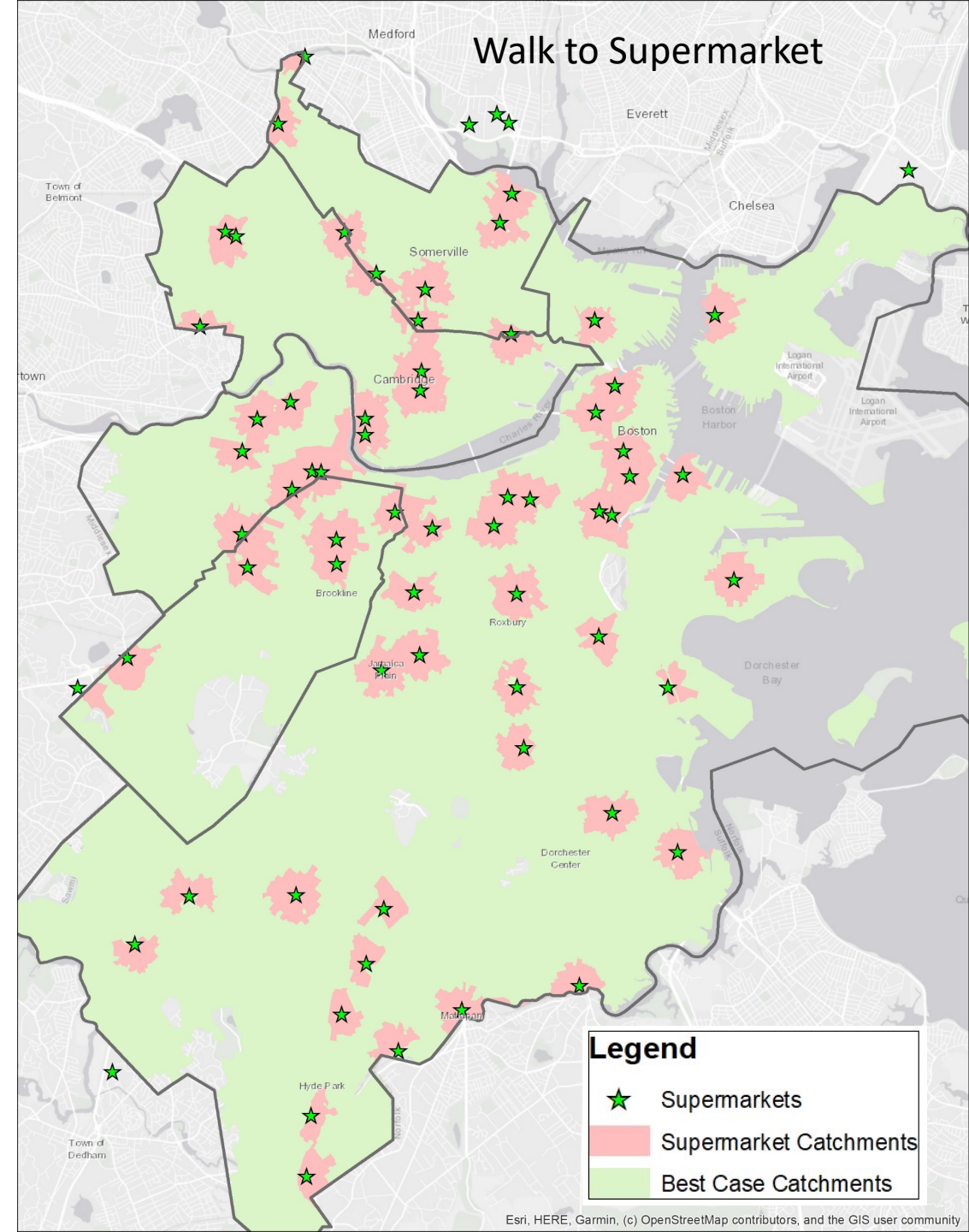
Peter G Furth

Northeastern University

Stephanie Upson

MassDOT

Theja Putta

Toole Design Group

What can compete with cars for grocery shopping?

- Walking & transit are poor competitors
  - After 5 min, groceries become heavy!
- Bicycling is
  - Sustainable
  - Affordable and thus Equitable
  - Practical – easily carry 30 pounds
- What's needed:
  - A bike
  - Parking racks
  - A safe route to get there

Walk to Supermarket

Legend
★ Supermarkets
█ Supermarket Catchments
█ Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

How are we doing?

- Pretty well in some places
  - Overall, 47% of homes can reach a supermarket on foot or on a low-stress bike route.

- Rather poorly elsewhere …
  - Especially where affordability / equity matters the most
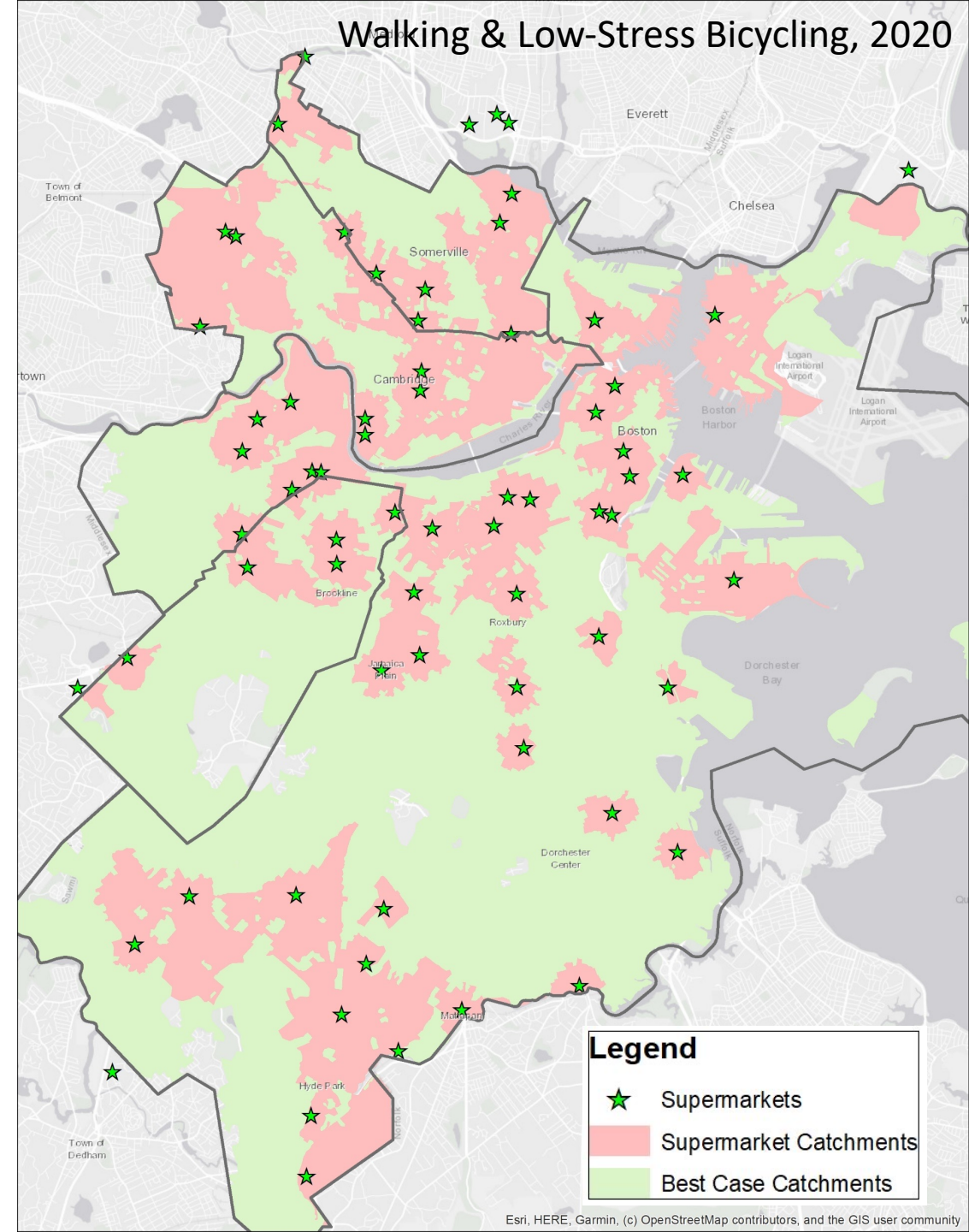
Walking & Low-Stress Bicycling, 2020

Legend

★ Supermarkets

Supermarket Catchments

Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

What Actions to Improve Access?

1. **A connected, low-stress bike network** at the city / region level – just as needed for bike-to-work, etc.

2. **Contraflow on local streets**
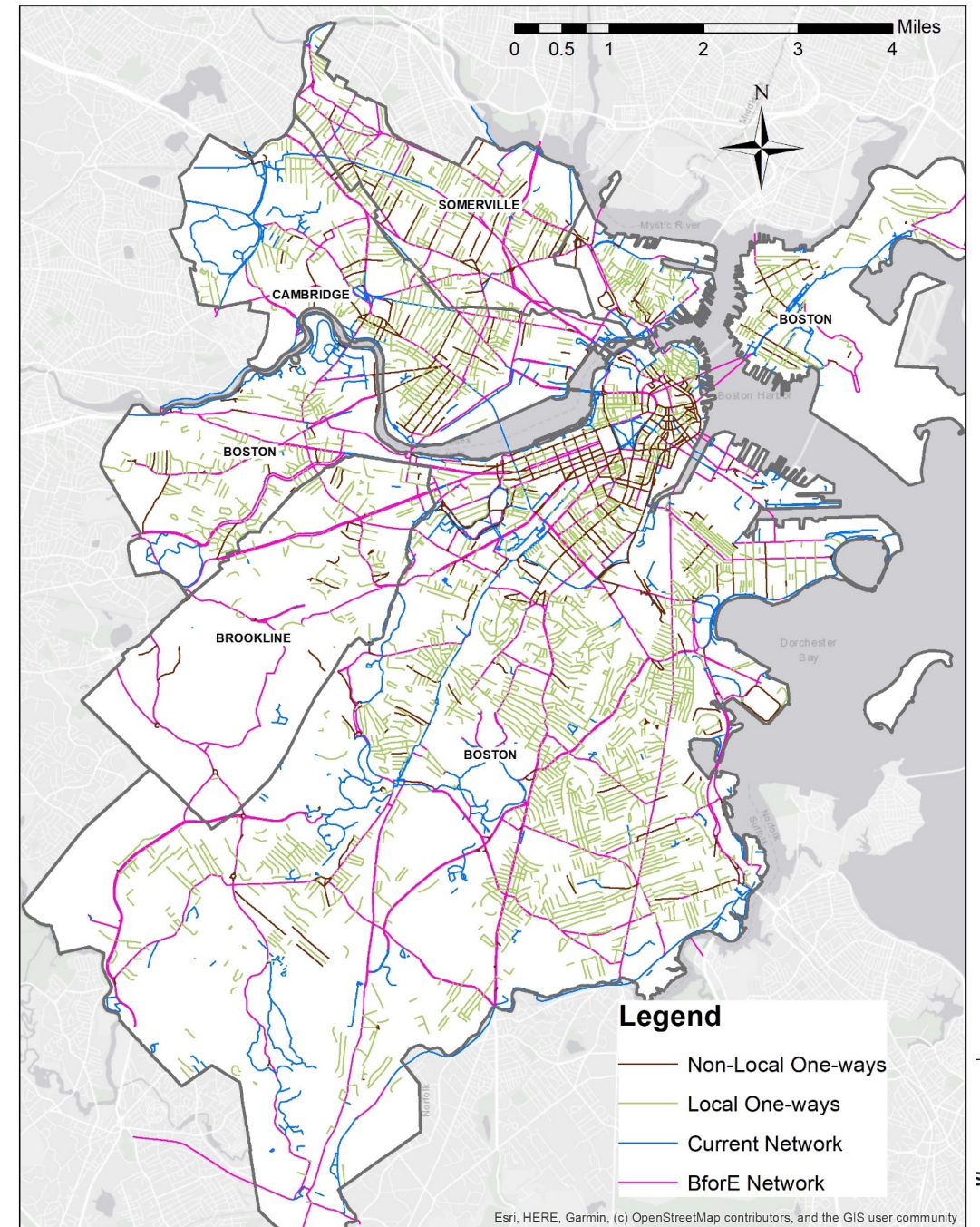
What Actions to Improve Access?

1. **A connected, low-stress bike network** at the city / region level – just as needed for bike-to-work, etc.

2. **Contraflow on local streets**
   - Affects many neighborhoods with narrow street and dense housing whose local streets were made one-way around 1970 to fit more and more parked cars
   - People need a low-stress route to the supermarket *and back home again*

What Actions to Improve Access?

3. Hyper-local improvements
   - Remove barriers to low-stress bicycling within 0.1 miles (528 ft) of the supermarket
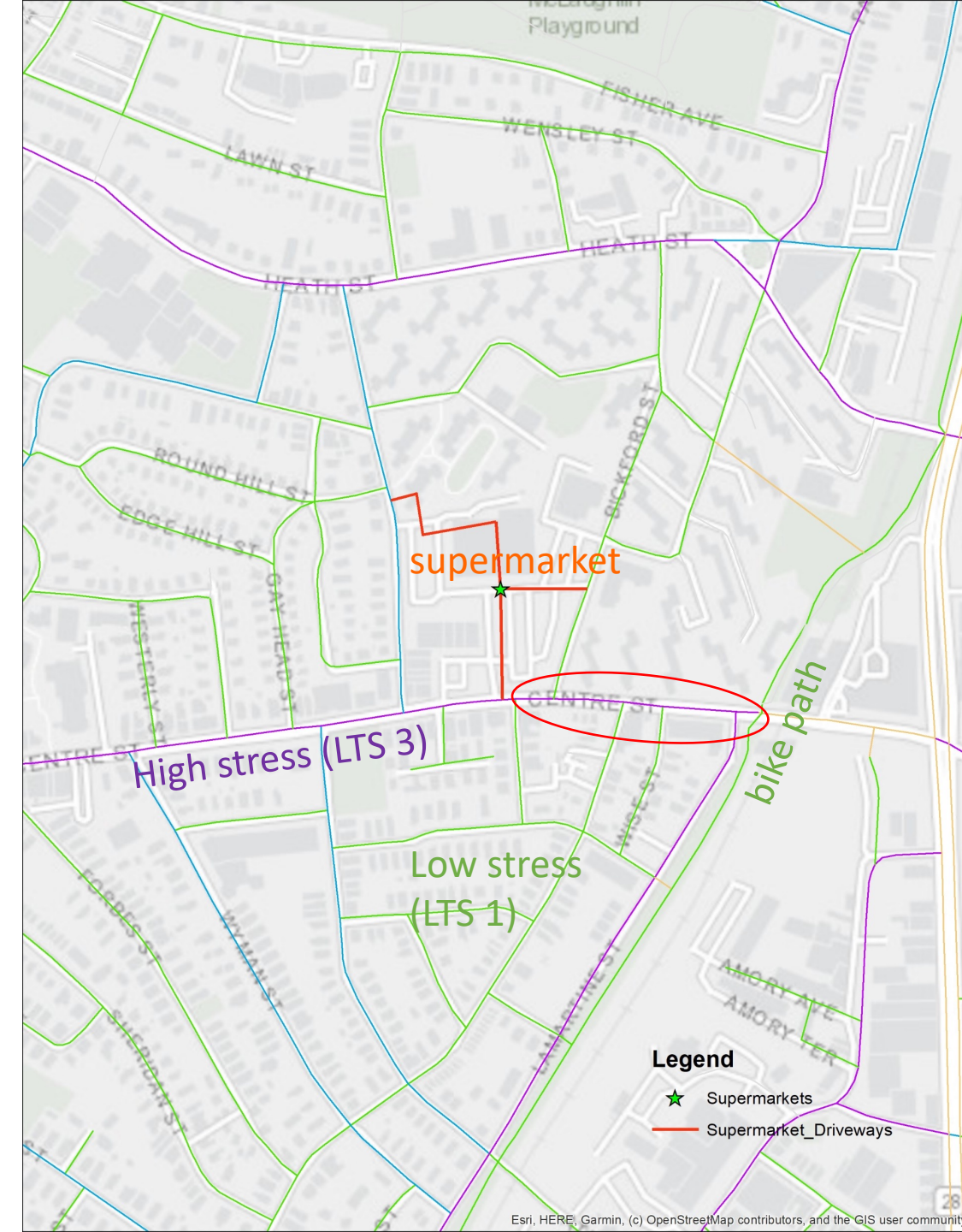
Data: Supermarket locations

- All supermarkets within 1 mile of Boston, Brookline, Cambridge, and Somerville

- "Supermarket" = full range of foods, fresh produce, and low prices
  - Excludes convenience stores and corner stores
  - 14,000 sq ft or larger
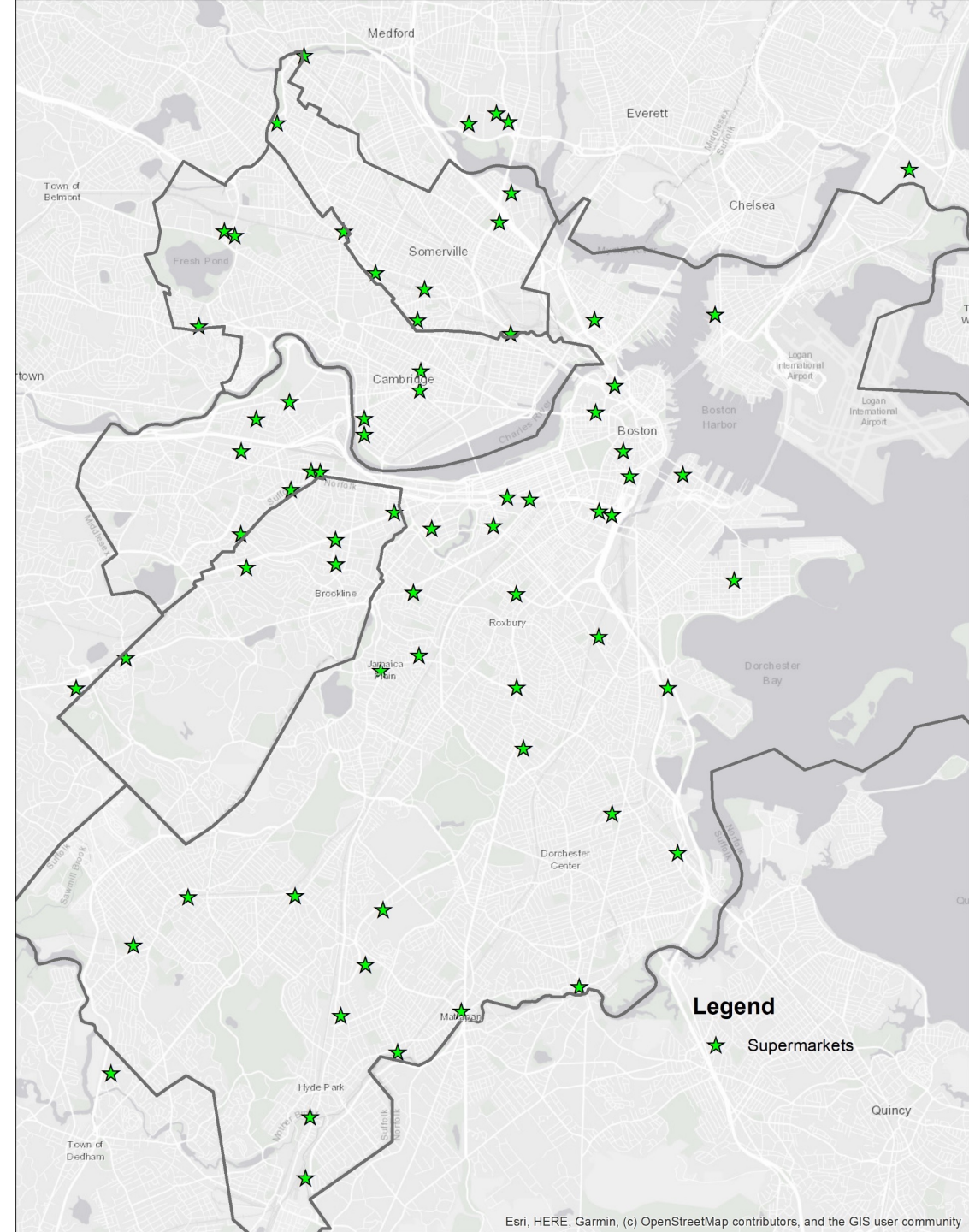
Data: What Counts as a Supermarket?

Metro Area Planning Council,
Food Retailers

Boston Transportation Dep't,
High Quality Grocery Stores

Northeastern University,
Supermarkets > 14,000 sq ft
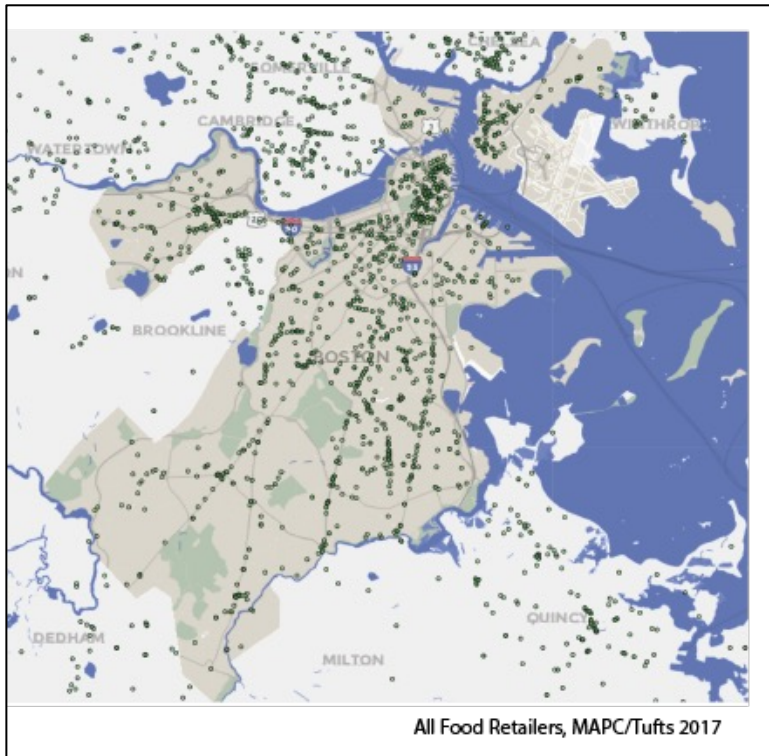
All Food Retailers, MAPC/Tufts 2017

High Quality Grocery Stores, 2023 BTD
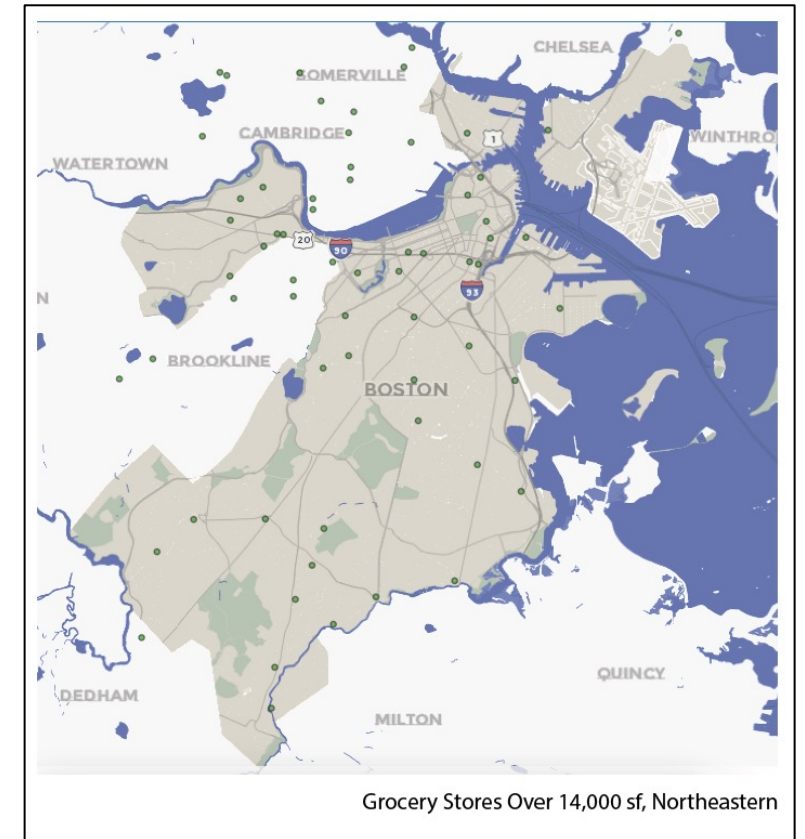
Grocery Stores Over 14,000 sf, Northeastern

Data: What is the Low-Stress Bike Network

- Cleaning / correcting the street network
- Adding data on bike infra
  - Attention: connections between streets and paths
- Supplying missing data
  - Does the street have a centerline?
  - If there's a bike lane, is there a parking lane, too?
  - Traffic volume and speed
- Apply Level of Traffic Stress criteria to classify streets
- Review, clean some more
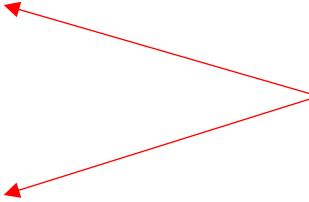
Data: Supermarket Driveways

- Supermarkets are "point features," often well removed from any street
  - Without adding driveway, GIS will "snap" it to the closest street.
- Driveways were added reflect how supermarket entrances actually connect to the street network

Legend

★ Supermarkets

— Supermarket_Driveways

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
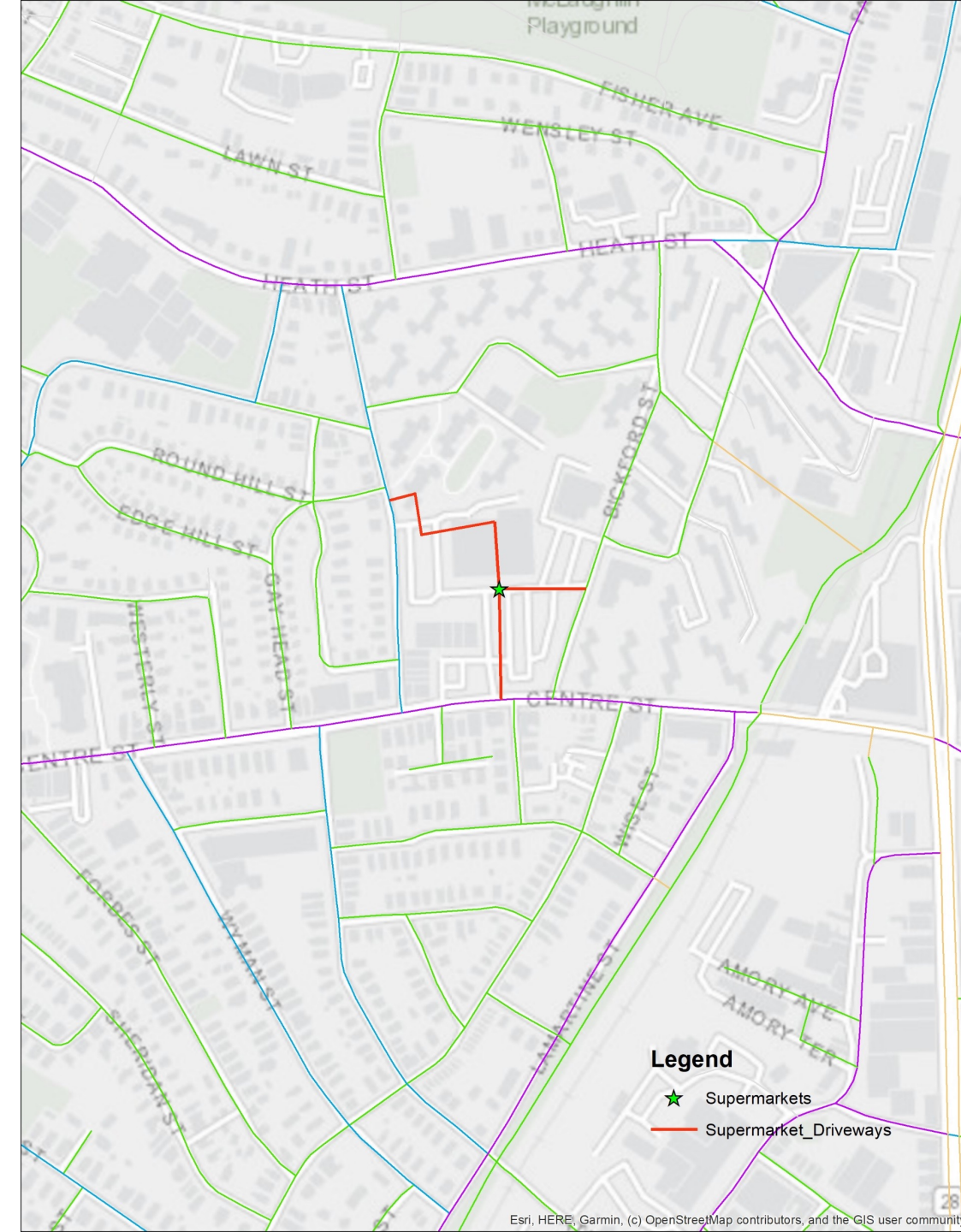
Accessibility Parameters Used

Distance Limits

- Walking: 7 minutes (0.35 miles)
  - Because groceries become heavy!
- Bicycling
  - "Close": 7 minutes (1.17 miles)
  - "Reachable:" 10 minutes (1.67 miles)

"CLOSE"

Access Quality

- Good: Close AND "Choice" (= 2 or more supermarkets are reachable)

- Moderate: Close OR Choice

- Basic: 1 supermarket is reachable

Catchment areas (1.67 mi) for Different Network Improvement Scenarios

S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	Contraflow on local and low-volume streets
S6	Both S4 and S5 combined
S7	BforE (Bikeways for Everybody – city network)
S8	BforE + 0.1 miles
S9	BforE + Contraflow
S10	BforE + 0.1 mile + contraflow

S1: Walk Only

Legend

★ Supermarkets

Supermarket Catchments

Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
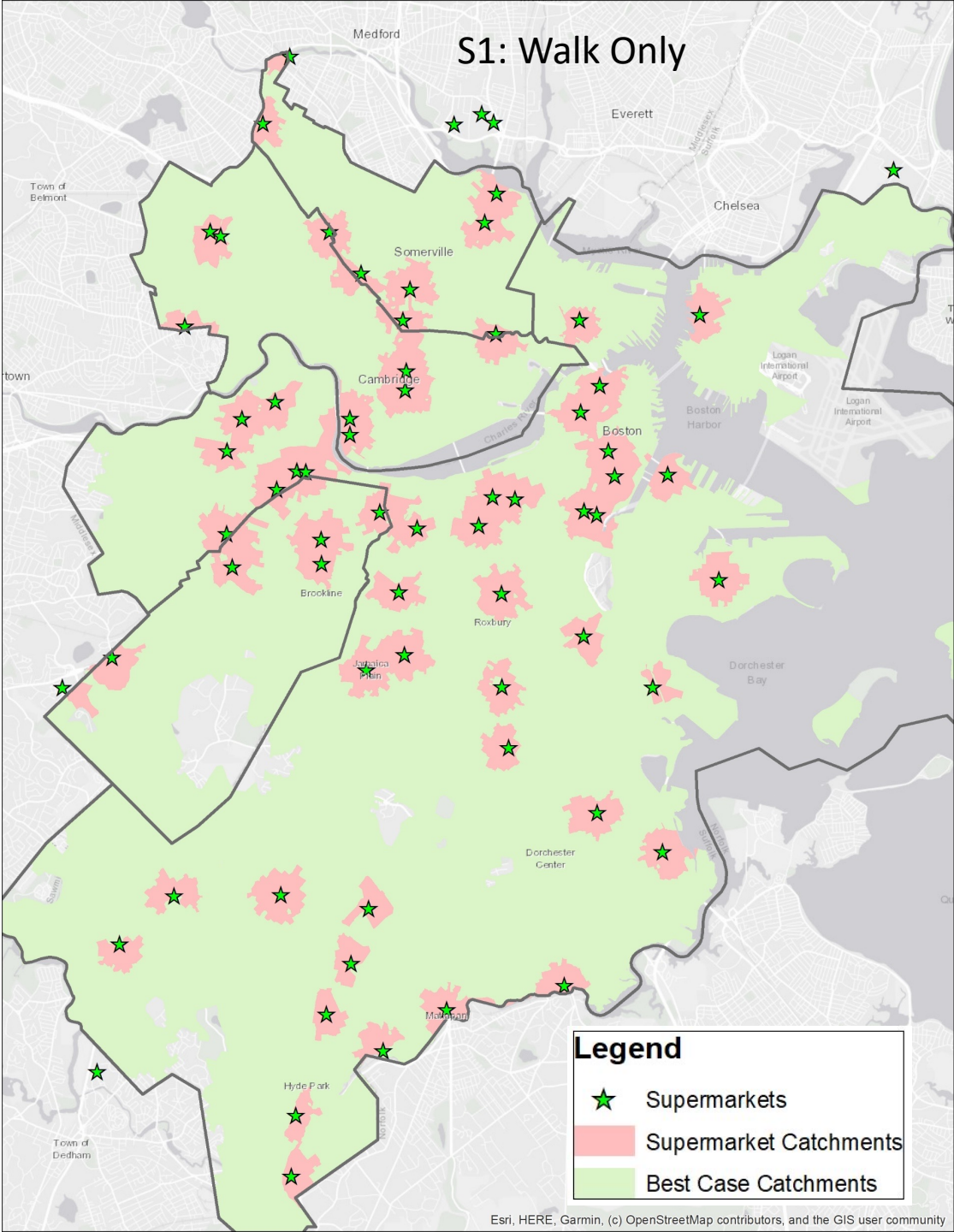
Present day (early 2020)

S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	Contraflow on local and low-volume streets
S6	Both S4 and S5 combined
S7	BforE (Bikeways for Everybody – city network)
S8	BforE + 0.1 miles
S9	BforE + Contraflow
S10	BforE + 0.1 mile + contraflow

S3: Existing (2020)

Legend
★ Supermarkets
Supermarket Catchments
Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
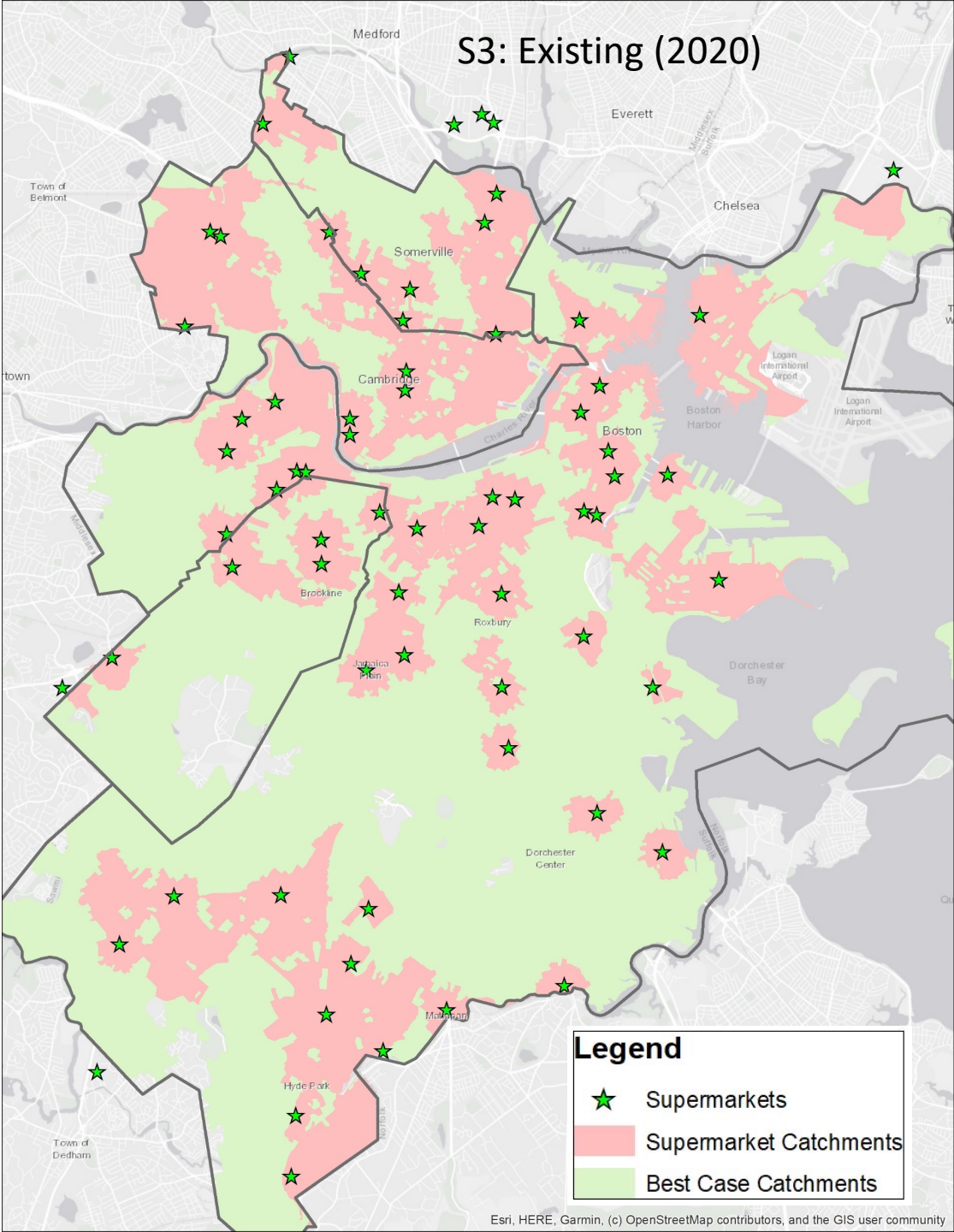
Remove barriers within 0.1 miles

S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	Contraflow on local and low-volume streets
S6	Both S4 and S5 combined
S7	BforE (Bikeways for Everybody – city network)
S8	BforE + 0.1 miles
S9	BforE + Contraflow
S10	BforE + 0.1 mile + contraflow

S4: Hyper-local (0.1 mi) improvements

Legend

★ Supermarkets

Supermarket Catchments

Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Contraflow on local streets

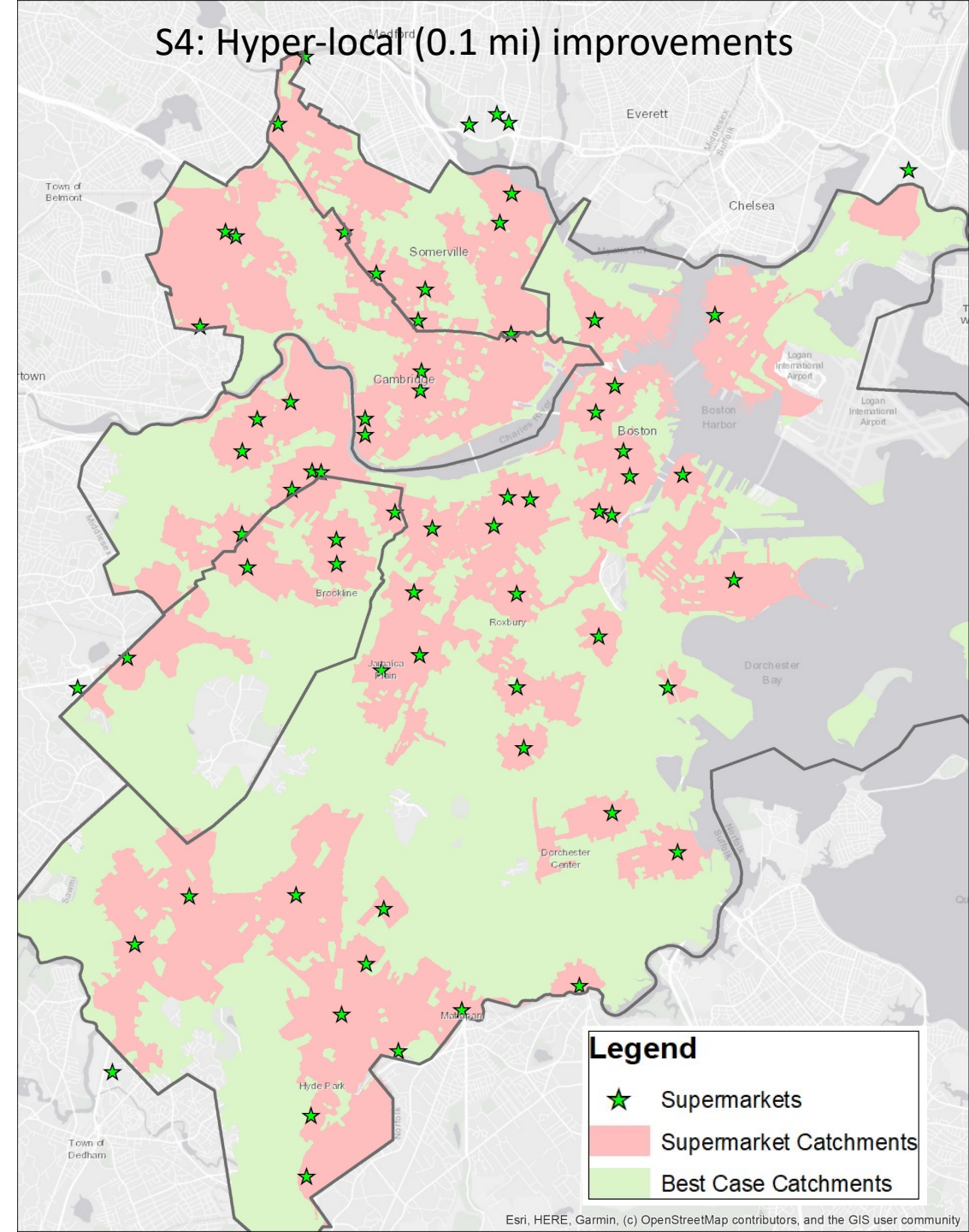|	
S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	**Contraflow on local and low-volume streets**
S6	Both S4 and S5 combined
S7	BforE (Bikeways for Everybody – city network)
S8	BforE + 0.1 miles
S9	BforE + Contraflow
S10	BforE + 0.1 mile + contraflow

S5: Contraflow on local streets

Legend
★ Supermarkets
Supermarket Catchments
Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Contraflow + Hyper-local

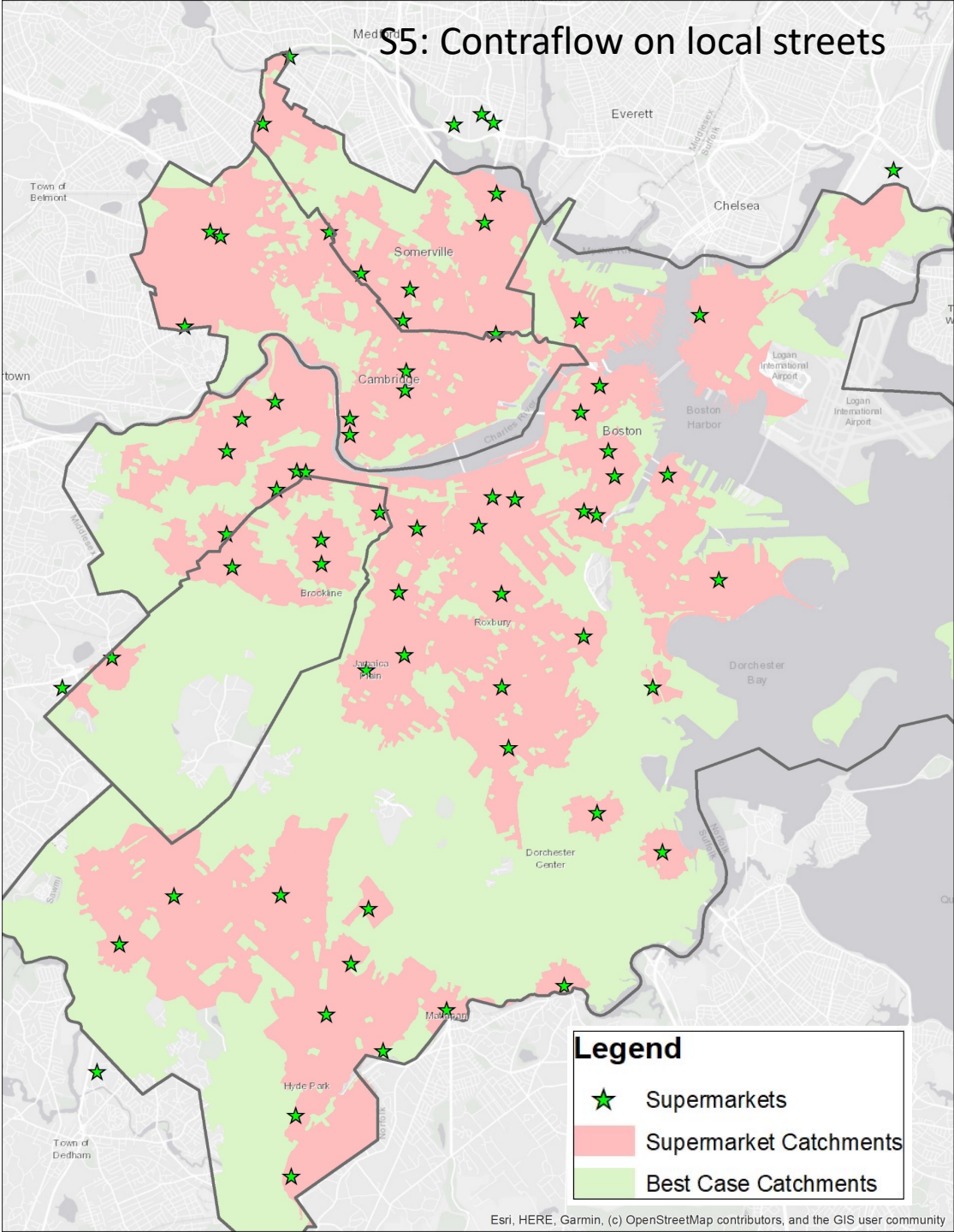|	
S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	Contraflow on local and low-volume streets
S6	Both S4 and S5 combined
S7	BforE (Bikeways for Everybody – city network)
S8	BforE + 0.1 miles
S9	BforE + Contraflow
S10	BforE + 0.1 mile + contraflow

S6: Contraflow & Hyper-local improvements

Legend
★ Supermarkets
▨ Supermarket Catchments
▨ Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

City-level Bike Network
(B for E, bikeways for everybody)

S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	Contraflow on local and low-volume streets
S6	Both S4 and S5 combined
S7	**BforE (Bikeways for Everybody – city network)**
S8	BforE + 0.1 miles
S9	BforE + Contraflow
S10	BforE + 0.1 mile + contraflow

S7: City bike network (B for E)

Legend

★ Supermarkets

▉ Supermarket Catchments

▉ Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

City bike network + Hyper-local
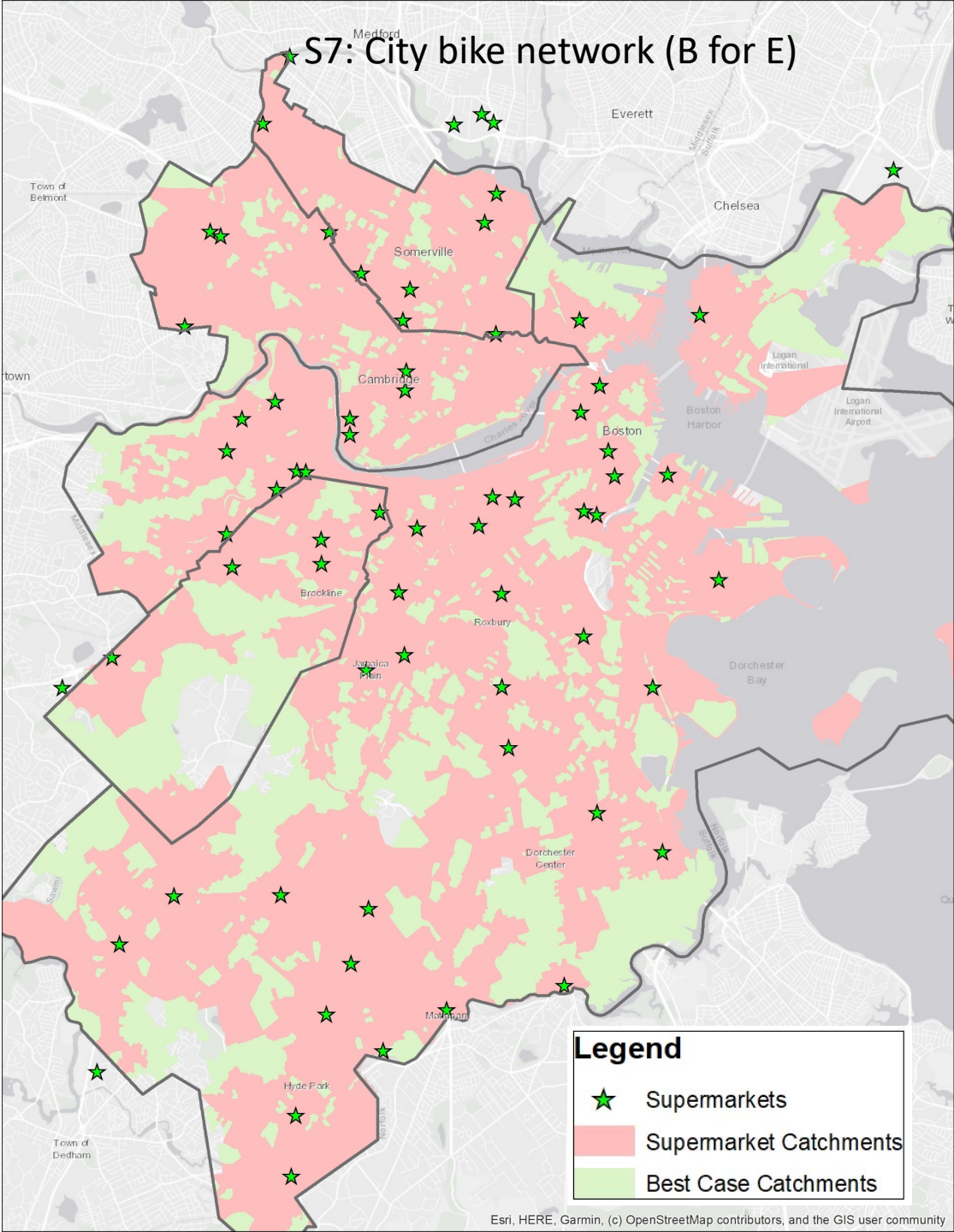
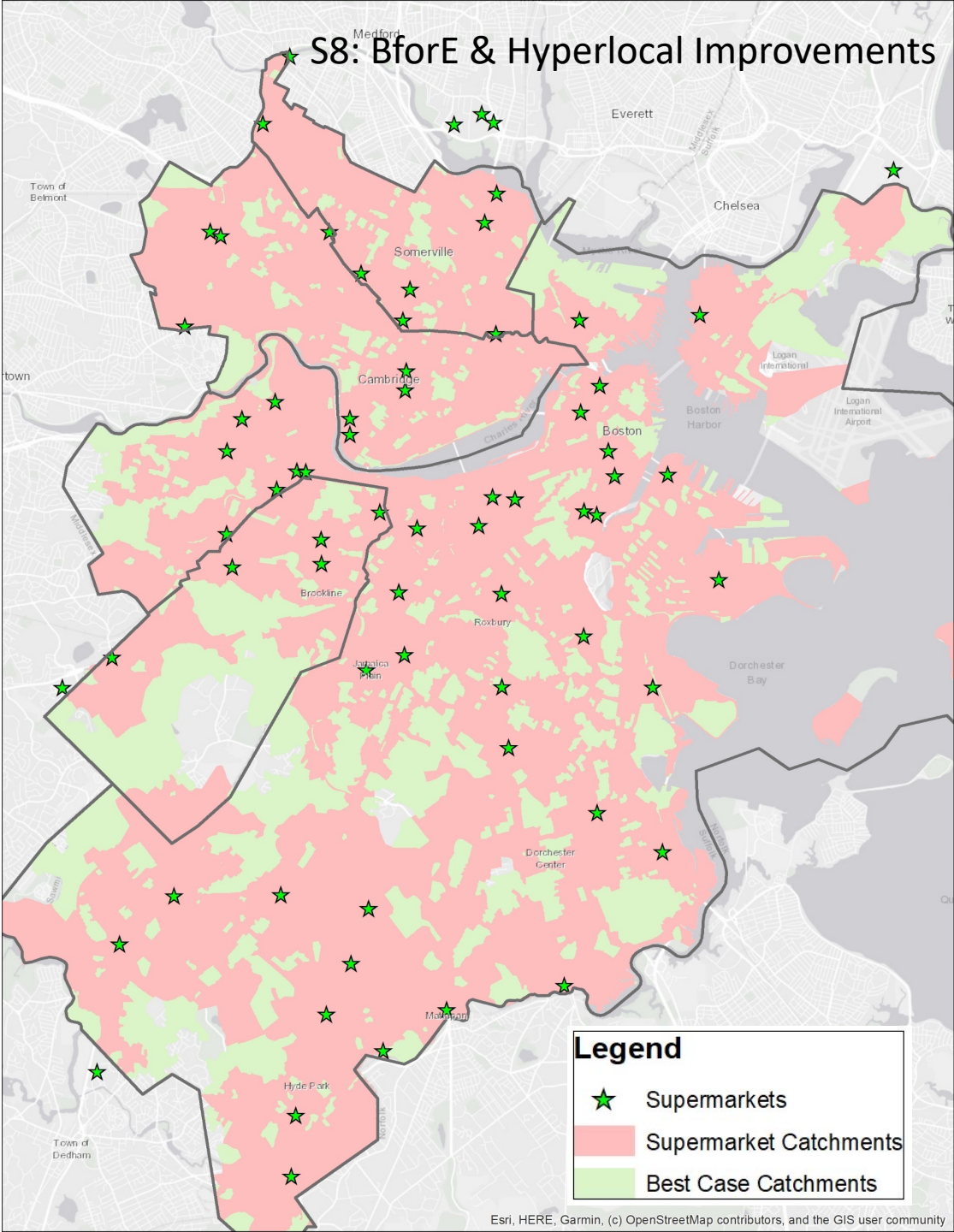|	
S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	Contraflow on local and low-volume streets
S6	Both S4 and S5 combined
S7	BforE (Bikeways for Everybody – city network)
S8	BforE + 0.1 miles
S9	BforE + Contraflow
S10	BforE + 0.1 mile + contraflow

S8: BforE & Hyperlocal Improvements

Legend

★ Supermarkets

Supermarket Catchments

Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

City bike network + Contraflow

S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	Contraflow on local and low-volume streets
S6	Both S4 and S5 combined
S7	BforE (Bikeways for Everybody – city network)
S8	BforE + 0.1 miles
S9	**BforE + Contraflow**
S10	BforE + 0.1 mile + contraflow

City bike network + Hyper-local + Contraflow

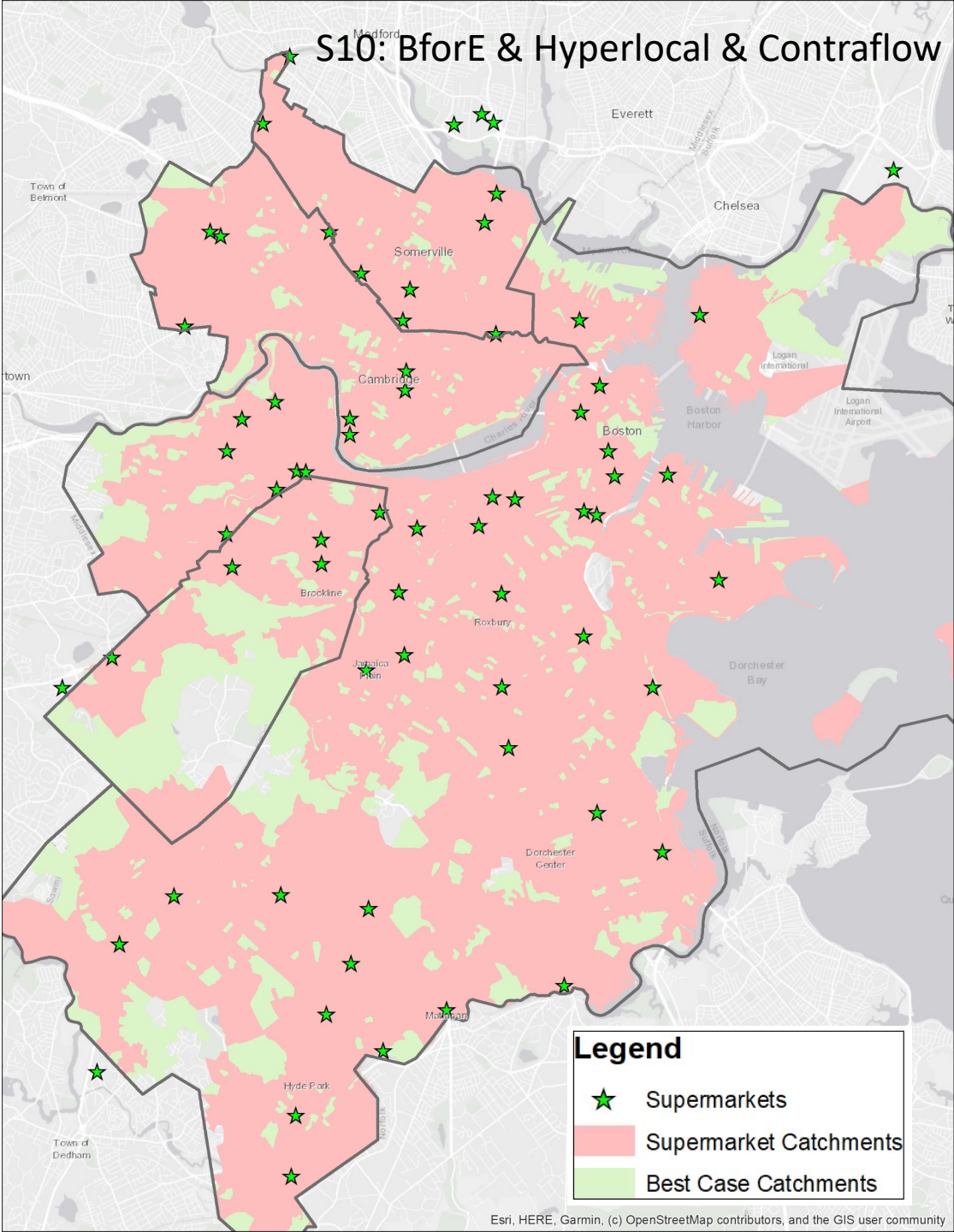|	
S1	Walk only
S2	Best case (all streets are low-stress)
S3	Present day (early 2020)
S4	Remove barriers within 0.1 miles
S5	Contraflow on local and low-volume streets
S6	Both S4 and S5 combined
S7	BforE (Bikeways for Everybody – city network)
S8	BforE + 0.1 miles
S9	BforE + Contraflow
S10	BforE + 0.1 mile + contraflow

S10: BforE & Hyperlocal & Contraflow

Legend
★ Supermarkets
■ Supermarket Catchments
■ Best Case Catchments

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Results

Percentage of population with different levels of access to supermarkets
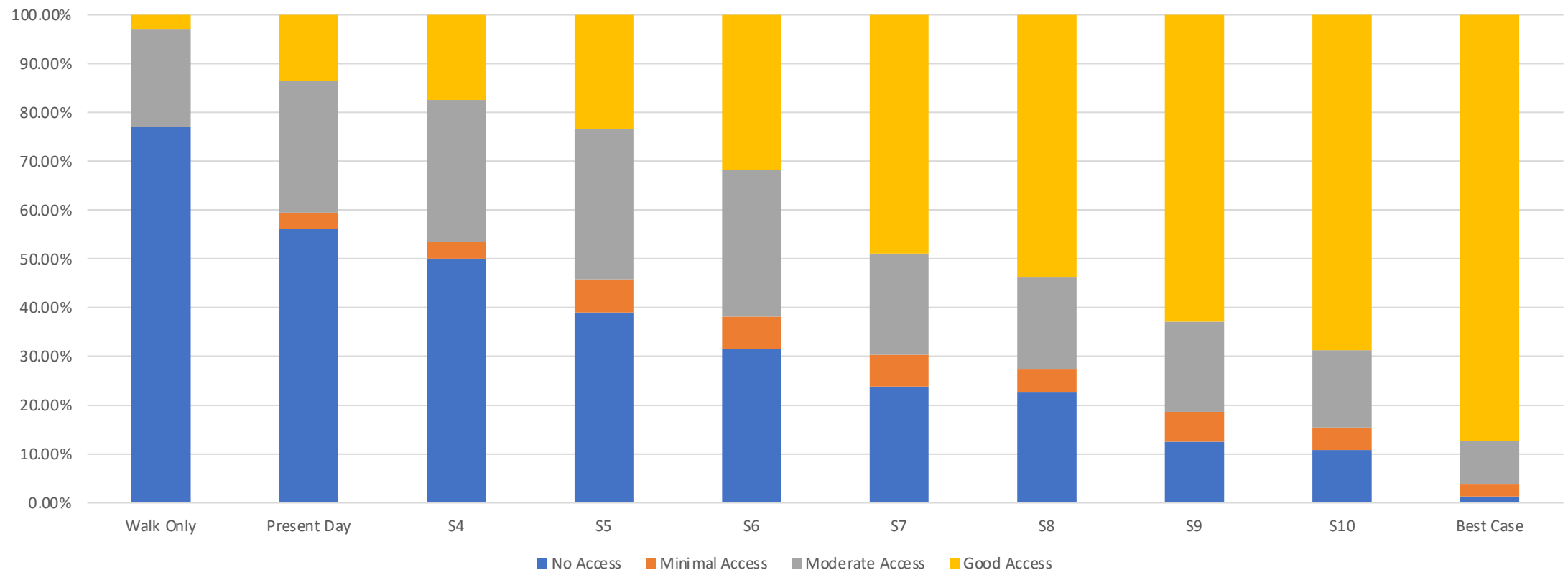
Conclusions

1. *Want sustainability – equity – affordability in access to supermarkets?* Gotta promote bicycling!

2. Bike-to-supermarket needs a city-level low-stress bike network, same as bike-to-work, etc., but it also needs …

3. Low-stress links and barrier removal in the immediate vicinity of supermarkets, and

4. Contraflow on local streets *so you can get there and back.*

5. We can increase the fraction with "good access" to supermarkets from 3% to 87%+ …

6. And decrease the fraction without basic access from 77% to 10% or less

Low Stress Bike Accessibility to Supermarkets in Greater Boston

Peter G Furth, Northeastern University

Stephanie Upson, MassDOT

Theja Putta, Toole Design Group

Results

nClose	nChoice	Walk Only	Present Day	S4	S5	S6	S7	S8	S9	S10	Best Case
0	0	660416	481528	428441	334150	269938	204035	193422	107055	92915	11458
0	1	0	28035	29230	58175	57337	55512	40638	52666	39479	20669
0	2	0	8549	8036	22889	19855	17236	23847	17256	23156	20360
0	3	0	1560	3395	4646	6345	13510	15251	11577	14142	12025
1	1	170673	222025	238662	235846	230200	147798	122571	129730	98629	44249
1	2	0	26903	32349	49036	59594	48049	52836	52480	63716	40512
1	3	0	6284	13818	17823	23977	79443	85187	91180	93283	86221
2	2	25127	50765	52802	70880	65804	39720	43412	44462	51238	29671
2	3	0	18303	26791	33547	58498	104713	114325	136507	146479	171073
3+	3+	909	13173	23601	30133	65577	147109	165636	214212	234088	420887
	Total	857125	857125	857125	857125	857125	857125	857125	857125	857125	857125